

CELERE 2015 Design Challenge

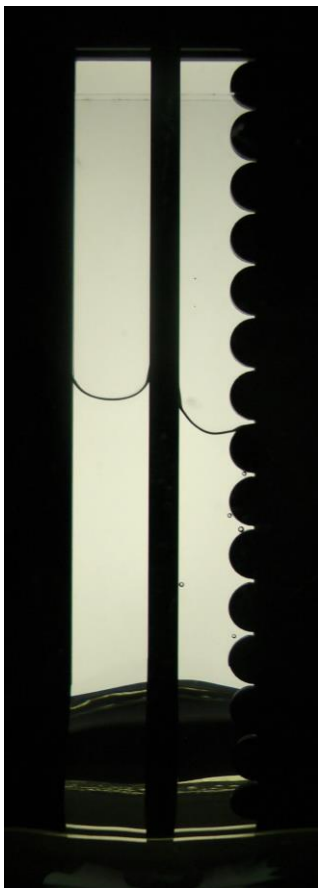


A joint STEM educational program

where STEM = Science, Technology, Engineering, Mathematics



WHAT? The *Capillary Effects on Liquids Exploratory Research Experiments (CELERE) Design Challenge* (<http://spaceflight systems.grc.nasa.gov/CELERE/>) is a joint educational program of NASA and Portland State University (PSU) enabling students to participate in microgravity research on capillary action related to that conducted on the International Space Station (ISS). The students create their own experiments using Computer-Aided Design (CAD) with a provided template and *DraftSight* software, which can be downloaded for free from www.3ds.com/products-services/draftsight/download-draftsight/. Experiment proposals, which consist primarily of a single CAD drawing, are submitted to NASA. The test cells are then manufactured by PSU using the drawings and a computer-controlled laser cutter. Each experiment is conducted in PSU's Dryden Drop Tower (www.ddt.pdx.edu), where it will fall 22 meters (73 feet) and experience 2.1 seconds of apparent near weightlessness, i.e., microgravity. Video and still images from each drop are provided online for student analysis and the reporting of results, for example in a science fair or class presentation. The example image below shows an experiment (from Columbus, GA) during the middle of the drop, where the scalloped channel wall has slowed the upward motion of the oil (relative to the oil's motion in the straight-walled channel).



WHO? The *CELERE 2015 Design Challenge* is for students in grades 8-12, who may participate as individuals or in teams of any size. Teams may include younger students as long as there is at least one team member in grades 8-12, where this option can facilitate the participation of informal science clubs, Scouts, etc. The program is limited to students from the United States, but is open to all fifty states, the District of Columbia, Puerto Rico, American Samoa, the Commonwealth of the Northern Mariana Islands, Guam, and the U.S. Virgin Islands. Youth are free to get help from adults, for example in creating their CAD drawing.

WHEN? CELERE tests will be conducted in three sets in early 2015, where the experiment proposals are submitted by e-mail to celere@lists.nasa.gov by the first of February, March, and April; choose one. Selected experiments are conducted approximately 1 month after the submission deadline.

WHERE? Students participate remotely, without travelling to PSU or NASA. But they can interact with NASA by e-mail, teleconferencing, or video conferencing.

WHY? CELERE enables students to participate in research related to space station science and learn about computer technology (e.g., CAD), both of which can inspire the pursuit of STEM careers. Boy Scouts could use the CAD drawing toward completion of the *Drafting* merit badge. And selection in a nation-wide NASA design challenge is an accomplishment worth noting on college applications!



CAPILLARY ACTION? Capillary action occurs when liquid molecules are more attracted to a surface than to each other. In paper towels, the water molecules move along tiny fibers. In plants (like celery), the water moves upward through narrow tubes called capillaries. For more basic information about capillary action, see: <http://ga.water.usgs.gov/edu/capillaryaction.html>. Capillary action occurs on Earth, but can be difficult to observe - except with small capillaries - because of gravity. But when experiments fall in a drop tower, capillary effects are easy to see and study!

DROP TOWER? When an experiment falls down PSU's Dryden Drop Tower (see left), it behaves as if gravity has nearly vanished – of course neglecting the fall! Our sensation of gravity and weight comes from a resistance to its pull, for example because of the floor holding us up. While freely falling, we feel weightless and that is the basis for many amusement park rides. This works because all objects fall at the same acceleration unless acted upon by another force. As one result, the astronauts and the ISS fall together (around the Earth) such that the astronauts float within the space station. This happens even though the space station is so close to the Earth that the gravity is only about 10% less than that on the planet's surface.

PSU? Prof. Mark Weislogel of the Portland State University (PSU) is a world leader in the study of capillary action and with NASA support has had such experiments conducted in drop towers, on the space shuttle, on the Russian *Mir* space station, and on the ISS where the latter includes:

Capillary Channel Flow (CCF)

<http://spaceflightsystems.grc.nasa.gov/SOPO/ICHO/IRP/MSG/CCF/>

Capillary Flow Experiment (CFE)

<http://spaceflightsystems.grc.nasa.gov/SOPO/ICHO/IRP/MWA/CFE/>

Astronauts who've worked on CFE (for example) include: Joe Acaba, Clay Anderson, Dan Burbank, Chris Cassidy, Cady Coleman, Tracy Caldwell Dyson, Mike Fincke, Kevin Ford, Mike Fossum, Mike Hopkins, Scott Kelly, Mike Lopez-Alegria, Bill McArthur, Tom Marshburn, Karen Nyberg, Don Pettit, Shannon Walker, Peggy Whitson, Jeff Williams, and Sunita Williams (seen operating CFE on the right).



MORE LINKS?

CELERE on Facebook

www.facebook.com/NASA.celere

CFE Interview (Nov. 14, 2014)

www.youtube.com/watch?v=GHwK2XeWuT0

NASA: What is Microgravity?

www.nasa.gov/centers/glenn/shuttlestation/station/microgex.html

NASA Education: Microgravity

www.nasa.gov/audience/foreducators/microgravity/

NASA Teaching Materials

www.nasa.gov/education/materials/

HyperPhysics: Capillary Action

<http://hyperphysics.phy-astr.gsu.edu/hbase/surten2.html#c4>

QUESTIONS? See <http://spaceflightsystems.grc.nasa.gov/CELERE/> or e-mail celere@lists.nasa.gov.